CLAIMS

WHAT IS CLAIMED IS:

1. A positive electrode for a lithium-sulfur battery comprising:

a current collector having pores; and

a positive active mass comprising a sulfur-based active material, a conductive agent, and a binder disposed in the pores of said current collector.

2. The positive electrode of claim 1, wherein the sulfur-based active material is at least one selected from the group consisting of elemental sulfur, solid Li_2S_n ($n \geq 1$), a catholyte in which Li_2S_n ($n \geq 1$) dissolves, an organosulfur compound, and a carbon-sulfur polymer.

3. The positive electrode of claim 1, wherein the pores of said current collector comprise at least 60% porosity of an overall volume of said current collector.

4. The positive electrode of claim 1, wherein the pores of said current collector comprise at least 80 to 90% porosity of an overall volume of said current collector.

5. The positive electrode of claim 1, wherein said porous current collector comprises a resin foam coated with a metal, where the coated resin foam is subjected to a pyrolysis process.

6. The positive electrode of claim 5, wherein said porous current collector further comprises a conductive agent.

7. The positive electrode of claim 1, wherein said porous current collector comprises a non-woven fabric coated with a metal.

8. The positive electrode of claim 1, wherein said porous current collector comprises a carbon fiber.

9. The positive electrode of claim 5, wherein the metal is coated using a coating method that comprises one of electroplating and electroless plating.

10. The positive electrode of claim 7, wherein the metal is coated using a coating method that comprises one of electroplating and electroless plating.

11. The positive electrode of claim 5, wherein the metal is at least one selected from the group consisting of nickel, aluminum, and mixtures thereof.

12. The positive electrode of claim 7, wherein the metal is at least one selected from the group consisting of nickel, aluminum, and mixtures thereof.

13. A lithium-sulfur battery comprising:

a positive electrode comprising a current collector having pores, a sulfur-based active material, a conductive agent, and a binder disposed in the pores of the current collector;

a negative electrode comprising a negative active material selected from the group consisting of a material which can reversibly intercalate/deintercalate lithium ions, a material which can reversibly reform a chemical compound with lithium, a lithium metal, and a lithium-containing alloy;

a separator interposed between said positive electrode and said negative electrode; and

an electrolyte impregnated into said negative electrode, said positive electrode, and said separator, and which comprises a lithium salt and an organic solvent.

14. The lithium-sulfur battery of claim 13, wherein the sulfur-based positive active material is at least one selected from the group consisting of elemental sulfur, solid Li_2S_n ($n \geq 1$), a catholyte in which Li_2S_n ($n \geq 1$) dissolves, an organosulfur compound, and a carbon-sulfur polymer.

15. The lithium-sulfur battery of claim 13, wherein the pores of the current collector comprise at least 60% porosity of an overall volume of the current collector.

16. The lithium-sulfur battery of claim 13, wherein the pores of the current collector comprise 80 to 90% porosity of an overall volume of the current collector.

17. The lithium-sulfur battery of claim 13, wherein the porous current collector comprises a resin foam coated with a metal, where the coated resin foam was subjected to a pyrolysis process.

18. The lithium-sulfur battery of claim 17, wherein the porous current collector further comprises a conductive agent.

19. The lithium-sulfur battery of claim 13, wherein the porous current collector comprises a non-woven fabric coated with a metal.

20. The lithium-sulfur battery of claim 13, wherein the porous current collector comprises a carbon fiber.

21. The lithium-sulfur battery of claim 17, wherein the metal is coated using a coating method that is one of electroplating and electroless plating.

22. The lithium-sulfur battery of claim 19, wherein the metal is coated using a coating method that is one of electroplating and electroless plating.

23. The lithium-sulfur battery of claim 17, wherein the metal is at least one selected from the group consisting of nickel, aluminum and mixtures thereof.

24. The lithium-sulfur battery of claim 19, wherein the metal is at least one selected from the group consisting of nickel, aluminum and mixtures thereof.

25. A lithium sulfur battery, comprising:

a positive electrode comprising a current collector having pores and with each pore having a conductive surface, and a positive active mass comprising a sulfur-based active material disposed in the pores contacting the conductive surfaces;

a negative electrode comprising a negative active material selected from the group consisting of a material which can reversibly intercalate/deintercalate lithium ions, a material which can reversibly reform a chemical compound with lithium, a lithium metal, and a lithium-containing alloy; and

an electrolyte to transfer metal ions and to separate said positive and negative electrodes.

26. The lithium sulfur batter of claim 25, wherein said electrolyte comprises one of a glass electrolyte, a polymer electrolyte, and a ceramic electrolyte.

27. The lithium sulfur batter of claim 26, wherein said electrolyte further comprises an electrolyte salt.

28. The lithium sulfur batter of claim 27, wherein said electrolyte further comprises less than 20 % of a non-aqueous organic solvent, and a gelling agent to reduce a fluidity of the organic solvent.

29. The lithium-sulfur battery of claim 25, wherein the pores of the porous current collector comprise at least 60% porosity of an overall volume of the porous current collector.

30. The lithium-sulfur battery of claim 25, wherein the porous current collector comprises a resin foam coated with a metal.

31. The lithium-sulfur battery of claim 25, wherein the porous current collector comprises a non-woven fabric coated with a metal.

32. A method of manufacturing a positive electrode for a lithium-sulfur battery, the method comprising:

obtaining a current collector having pores with each of the pores having conductive surfaces; and

inserting a positive active mass comprising a sulfur-based active material into the pores to contact the conductive surfaces.

33. The method of claim 32, wherein said obtaining the current collector comprises:

coating a resin foam with a metal; and

processing the coated resin foam using a pyrolysis process.

34. The method of claim 33, wherein said obtaining the current collector further comprises adding a conductive agent to the resin foam prior to coating the resin foam.

35. The method of claim 33, wherein the coating the resin foam with the metal comprises using one of electroplating and electroless plating to coat the metal.

36. The method of claim 35, wherein the metal is at least one selected from the group consisting of nickel, aluminum, and mixtures thereof.

37. The method of claim 32, wherein said obtaining the current collector comprises coating a non-woven fabric coated with a metal.

38. The method of claim 37, wherein the non-woven fabric comprises a carbon fiber.

39. The method of claim 37, wherein the coating the non-woven fabric with the metal comprises using one of electroplating and electroless plating to coat the metal.

40. The method of claim 39, wherein the metal is at least one selected from the group consisting of nickel, aluminum, and mixtures thereof.

41. The method of claim 32, wherein the sulfur-based active material comprises a solid sulfur compound, the method further comprising:

dissolving a binder and a conductive agent in a solvent to obtain a dispersion solution; and

adding the solid sulfur compound to the dispersion solution to be uniformly dispersed therein to form a slurry;

wherein said inserting the positive active mass comprises coating the slurry on the porous current collector.